THURSDAY, MAY 22, 1913.

THE ROYAL SOCIETY'S SUBJECT INDEX.

Royal Society of London. Catalogue of Scientific Papers, 1800–1900. Subject-Index, Vol. iii., Physics. Part i., Generalities, Heat, Light, Sound. Pp. c + 550 + vii. (Cambridge University Press, 1912.) Price 18*s.* net.

THE most obviously essential qualities of a work of reference such as this are accuracy, comprehensiveness, and a lucid arrangement of the contents, so that anyone using the book may readily find the information he is in search of. The test of accuracy must lie in the result of long usage, but, in the present case, so far as an *a priori* guarantee can go, we have it in the auspices under which the book is produced. As to comprehensiveness, while absolute completeness is no doubt unattainable, most of those who have occasion to consult the work before us will be satisfied with the statement that it "contains 33,344 entries referring to the papers contained in 1261 serial publications." Even these numbers convey little idea of the comprehensive scale of the whole book of which the volume we are considering forms a part, unless it is borne in mind that it deals with only those parts of the science of physics which are included under the headings generalities, heat, light, sound, leaving the great subjects electricity and magnetism for another volume, and unless we remember, further, that the whole of physics constitutes only one of seventeen sciences included in the schedule of the International Catalogue. These sciences are mathematics, mechanics, physics, chemistry, astronomy, meteorology, mineralogy, geology, geography, palæontology, biology, botany, zoology, anatomy, anthropology, physiology, and bacteriology.

The volume relating to pure mathematics was published in 1908 and contains 38,748 entries referring to 700 serials, and the volume on mechanics, published in 1909, contains 21,295 entries referring to the papers contained in 959 serials. This makes a total of 93,387 entries contained in the three already-published volumes of the catalogue, or, if we assume that the second half of "Physics" will yield as many as the first half, we get an estimated total of more than 126,000 entries for the first three sciences in the above list. Of the remainder, some will no doubt provide a smaller number than the average of those already dealt with, but others will probably furnish quite as many. This may suffice to give some idea of the comprehensive character and immense scale of the work which the Royal Society's committee has undertaken in the compilation of this catalogue.

The arrangement of the matter has obviously required very careful consideration. A purely alphabetical arrangement of such an immense number of entries relating to such a great variety of subjects would clearly have resulted in a series of bewildering lists wherein the search for a particular item would have been like that for a needle in hay. The arrangement actually adopted is founded on an elaborate attempt at a rational classification of the subject-matter of the sciences dealt with. This is carried out by a series of successive divisions and subdivisions, the nature of which can be best shown by an example. Thus the general subject of Heat is first distributed among the following main divisions: General; Sources of Heat and Cold; Thermometry; Relations involving Expansion and Stress; Calorimetry and Specific Heat; Phenomena of Change of State; Thermal Conduction and Convection; Thermo-dynamics. Each of these main divisions is subdivided into numbered headings; thus, to take a comparatively compact example, Calorimetry and Specific Heat comprises the following headings: 1600, General, Units of Heat; 1610, Calorimetric Methods; 1620, Specific Heats of Solids and Liquids; 1640, Specific Heats of Gases and Vapours; 1660, Chemical Constitution and Specific Heat; 1670, Heats of Fusion; 1680, Heats of Vaporisation; 1690, Heats of Dissolution; 1695, Heats of Transformation.

The numbers greatly facilitate cross-reference. It will be seen that they do not run continuously and that the intervals between them are not uniform. These intervals make it possible to expand the index in future by inserting additional entries without disturbing those to which numbers have already been assigned. For some rather occult reason the reference numbers all have four figures, the first half-dozen being 0000, 0010, 0020, 0030, 0032, 0040. These numbered headings are in most cases again subdivided, sometimes to a considerable extent, before we come to the references to individual papers.

The extreme terms of this series of divisions and subdivisions, namely, a branch of science and a particular paper relating to some matter falling under this branch, are determined by the nature of the case; but there is room for almost any amount of difference of opinion as to how many intermediate terms should be interposed, and where they should be placed. The ultimate criterion in this matter should be, in our opinion, the degree of ease and convenience with which a student wishing to follow up a particular subject can find references to what has been already published in relation to it. To facilitate this kind of reference is, in fact, the whole purpose of the book. Some degree of arrangement and classification of contents is needful to make the index usable at all, and this begins when one science is marked off from another; but the more minutely the classification is carried out, and the smaller the resulting classes become, the more chance there is of uncertainty as to the class in which a particular paper should be placed. If the question is answered in one way by the compilers of the index and in another way by a person who wishes to use it, the natural consequence is that he does not find the information he wants in the place he turns to first. The fact is that any possible classification is in a great degree arbitrary and conventional. The grouping of scientific results that at any time seems most natural and logical inevitably reflects not only the then existing state of knowledge, but also the successive stages by which that state of knowledge has been reached. New additions to scientific knowledge are not like bricks added to a building each of which occupies a fixed position and a sharply defined space; each newly recognised fact sheds light on what was known before and may greatly alter the apparent relative importance of previous acquisitions.

That such considerations are not irrelevant to the arrangement of this index is shown by the entry of thirteen references to papers on heat developed on moistening solids, under the general heading **0300 Capillarity,** and also under **Phenomena of Change of State, 1800 General.** There are, in fact, hosts of phenomena which are essentially related to more than one division of science, and papers dealing with them must necessarily be entered under more than one heading unless the index is to be encumbered by a tangle of cross-references.

We are fully conscious that the Royal Society's committee and the compilers of the index, who have considered the matter as a whole, may have good reasons for deciding on subdivisions and schemes of arrangement the advantages of which are not at once evident to anyone who has only partially examined a part of their work. It is therefore with the greatest diffidence that we venture to raise the question whether the classification on which the arrangement of the index is founded is not in some cases too minute. Thus the first entry under the heading **2410, Mechanical Equivalent of Heat,** gives a reference to Joule's classical paper in the Philosophical Transactions for 1850, and lower down, under the same general heading, we find references to Rowland's determination and to Reynolds and Moorby's; but Joule's final measurement (Phil. Trans., 1879) is given under a separate sub-heading, **Determination of Mechanical Equivalent,** under which we also find Griffiths (Phil. Trans., 1894), Miculescu (1892), and many others, and, under a sub-sub-heading, "Electrical Method," Joule's determination of 1867. We do not doubt that there are intelligible reasons for the separations and collocations of which these are examples, but we confess that to us personally they are more bewildering than helpful. For a long time we were not able to find any reference to Schuster and Gannon's measurement by the "electrical method," but at last we discovered it, as well as Rowland's and various other determinations, under "Specific Heat of Water." This is quite an appropriate place, but it is not easy to see why this paper should not also have been entered among determinations of the mechanical equivalent.

It is no doubt in consequence of our not having mastered the classification adopted by the committee that we have not been able to find references to such historically important investigations as those of Dulong and Petit into the expansion of mercury, the laws of cooling, and the specific heats of metals. The real difficulty of finding a thoroughly satisfactory system of arrangement arises partly from the enormous mass of material to be dealt with, but still more from the extreme complexity of the material. A strictly alphabetical arrangement offers an alluring simplicity, but a very slight examination of the contents of this volume must convince anyone that it would be hopeless to apply it until the matter has undergone a preliminary process of arrangement and sifting. The only questions that can arise are as to how this process shall be conducted, and how far it shall be carried; and probably scarcely any two men would answer these questions in exactly the same way.

There is no question that the index is a very remarkable and admirable piece of work, on which the Royal Society's committee, the director, Dr. McLeod, and all his colleagues deserve to be heartily congratulated. It will not only be of immense service to those engaged in the study of special questions, but it will help to keep alive a knowledge of the work of the men who laid the foundations of physical science. This work, like foundations generally, is apt to be buried out of sight as the superstructure rises, but it is well that modern builders should cherish the memory of those who made their work possible.

We find it difficult to close this volume without comparing it with Dr. Thomas Young's "Catalogue of Works relating to Natural Philosophy and the Mechanical Arts," published a little more than a century ago (1807), which, for its time, and as the work of one man, was as wonderful as the present index. The comparison affords a more trustworthy indication of the advance of natural knowledge during the nineteenth century than could probably be obtained in any other way.

G. C. F.

A NEW TEXT-BOOK OF MINERALOGY.

Mineralogy: an Introduction to the Theoretical and Practical Study of Minerals. By Prof. A. H. Phillips. Pp. viii+699. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1912.) Price 16*s*. net.

PROF. PHILLIPS'S text-book on mineralogy follows, on the whole, the usual lines of such works, and in price and size comes intermediately between Miers's well-known treatise, which appeared eleven years ago, and Dana's small book, a new edition of which, prepared by Ford, was published recently. By his experience in teaching the subject the author is well qualified to write a book suitable for students who wish to acquire a sound working knowledge of mineralogy.

As will be evident from the titles of the three parts into which it is divided, viz., crystallography, descriptive mineralogy, and determinative mineralogy, the book is comprehensive in its scope. Since each forms a subject wide enough to fill a book in itself, the author of a work dealing with all three is confronted with the difficulty of deciding how to keep the size within reasonable dimensions. On the whole, Prof. Phillips has succeeded in well covering all the ground necessary for the average student of mineralogy. We must acknowledge a debt of gratitude to him for resisting the temptation—irresistible to most writers on crystallography—of devising a brand new set of names for the thirty-two classes of crystal symmetry; he has wisely followed Miers, because the latter's nomenclature embodies the type of symmetry, and is therefore more easily remembered. Some surprise may be felt that little trace of Penfield's teaching should be evident in the discussion of the method of drawing crystals; the old one, in which an axial-cross is used, alone is considered, and no mention is made of the simple and convenient methods based upon the stereographic or gnomonic projections.

The whole subject of the goniometrical measurement of crystals is treated in a very elementary manner, and is confined to the instrument with a single circle; the theodolite goniometer, with two circles, which is used by many crystallographers in the United States, especially those who have studied under Goldschmidt, is not referred to, and it would seem that few students at Princeton University prosecute their studies very deeply into crystallography. The optical characters of crystals, on the other hand, are more fully dealt with, the reason no doubt being that an adequate knowledge is essential to the practical petrologist in the determination of the constituent minerals of a rock from a microscopic study of a thin-section.

The first part includes an interesting chapter on the relations of individual crystals, in which attention is directed to the parallel growths of one mineral on another, the full importance of which subject has largely been brought out by Barker's researches during recent years.

The second part includes three chapters which we should have imagined more in place in the first part, viz., the relation of the minerals to the elements, which covers such matters as topic parameters and the classification of minerals, the origin of minerals, and, lastly, the physical properties—for instance, cleavage and fracture, hardness, specific gravity, structure, colour, phosphorescence, &c. The part proper is devoted to concise descriptions of the characters and localities of the principal mineral species. At the head we have an abstract of their properties—chemical composition, crystalline system and type of symmetry, common forms, hardness, specific gravity, streak, colour, lustre, transparency, refractive indices—and then follows a general description of the crystals from the principal localities; in certain instances a few words are said about the use of the mineral or the metal derived from it.

Part iii. is given up to the methods of blowpipe analysis, the apparatus used, and the tables necessary for the identification of the various minerals, and is founded on Brush's well-known book. The tables provided include also one for the determination of minerals from their physical characters, dependence being placed mainly upon the hardness, streak of the softer and colour of the harder minerals, specific gravity, and cleavage, and another for the determination of the principal rock-forming minerals from their optical characters as given in a thin-section. The book ends with a full index, the use of which is facilitated by the employment of a different type for the numbers of the pages in each part of the book.

So far as we have tested it, the book seems satisfactorily accurate. Two curious mistakes have, however, crept into the description of the Cullinan diamond, the date of the discovery being wrongly stated to be June 6, instead of January 25, 1905, and the weight given being too high.